

IN THE CLAIMS

Please amend claims 2, 5, 7-10, 20, and 22-23 as follows below.

Please cancel claims 1 and 21 without prejudice.

Please add new claims 34-39 as follow below.

The following listing of claims replaces all prior versions, and listings, of claims in the application:

MARKED UP VERSION OF CLAIMS

- 1 1. (Cancelled)
- 1 2. (Currently Amended) An ~~[[The]]~~ integrated circuit
- 2 to interface to memory of claim 1, the integrated
- 3 circuit comprising:
- 4 a first off chip driver calibration terminal to
- 5 couple to an external pull-up resistor;
- 6 a second off chip driver calibration terminal to
- 7 couple to an external pull-down resistor;
- 8 a first switch coupled between the first off chip
- 9 driver calibration terminal and a voltage reference
- 10 node; and

11 a second switch coupled between the second off
12 chip driver calibration terminal and the voltage
13 reference node;

14 wherein the first switch and the second switch are
15 selectively closed to generate an internal voltage
16 reference on the voltage reference node with which an
17 input signal [[may be]] is compared in order to receive
18 data.

1 3. (Original) The integrated circuit of claim 2,
2 wherein

3 the first switch is selectively closed and the
4 second switch is selectively opened to generate a pull-
5 up calibration voltage on the voltage reference node to
6 calibrate an off-chip driver.

1 4. (Original) The integrated circuit of claim 3,
2 wherein

3 the first switch is selectively opened and the
4 second switch is selectively closed to generate a pull-
5 down calibration voltage on the voltage reference node
6 to further calibrate the off-chip driver.

1 5. (Currently Amended) An [[The]] integrated circuit
2 to interface to memory of claim 1, further the
3 integrated circuit comprising:

4 a first off chip driver calibration terminal to
5 couple to an external pull-up resistor;
6 a second off chip driver calibration terminal to
7 couple to an external pull-down resistor;
8 a first switch coupled between the first off chip
9 driver calibration terminal and a voltage reference
10 node;
11 a second switch coupled between the second off
12 chip driver calibration terminal and the voltage
13 reference node; and
14 a plurality of input receivers each having a first
15 input coupled to the voltage reference node and a
16 second input coupled to a respective data terminal of a
17 plurality of data terminals.

1 6. (Original) The integrated circuit of claim 5,
2 wherein

3 each input receiver includes
4 a comparator having a first input coupled to the
5 voltage reference node and a second input coupled to
6 the respective data terminal, the data terminal to
7 couple to an off-chip output driver for calibration.

1 7. (Currently Amended) An ~~[[The]]~~ integrated circuit
2 to interface to memory of claim 1, further the
3 integrated circuit comprising:

4 a first off chip driver calibration terminal to
5 couple to an external pull-up resistor;
6 a second off chip driver calibration terminal to
7 couple to an external pull-down resistor;
8 a first switch coupled between the first off chip
9 driver calibration terminal and a voltage reference
10 node;
11 a second switch coupled between the second off
12 chip driver calibration terminal and the voltage
13 reference node; and
14 a switch controller having a mode input, a first
15 control output coupled to a control input of the first
16 switch, and a second control output coupled to a
17 control input of the second switch, the switch
18 controller to control the opening and closing of the
19 first switch and the second switch in response to the
20 mode input.

1 8. (Currently Amended) The integrated circuit of
2 claim 7, wherein
3 the first switch and the second switch are
4 selectively closed to generate an internal voltage
5 reference on the voltage reference node with which an
6 input signal [[may be]] is compared in order to receive
7 data;

8 the first switch is selectively closed and the
9 second switch is selectively opened to generate a pull-
10 up calibration voltage on the voltage reference node to
11 calibrate an off-chip driver; and

12 the first switch is selectively opened and the
13 second switch is selectively closed to generate a pull-
14 down calibration voltage on the voltage reference node
15 to further calibrate the off-chip driver.

1 9. (Currently Amended) The integrated circuit of
2 claim [[1]] 2, wherein
3 the integrated circuit is a memory controller.

1 10. (Currently Amended) The integrated circuit of
2 claim [[1]] 2, wherein
3 the integrated circuit is a processor.

1 11. (Original) A method in an integrated circuit
2 for interfacing to a memory, the method comprising:
3 if in an off-chip driver calibration mode for a
4 pull-up, then
5 selecting a pull-up calibration terminal to
6 be coupled to a voltage reference node to provide
7 a pull-up calibration voltage thereon, and
8 calibrating a pull-up of an off chip driver;

9 if in an off-chip driver calibration mode for a
10 pull-down, then
11 selecting a pull-down calibration terminal to
12 be coupled to the voltage reference node to
13 provide a pull-down calibration voltage thereon,
14 and
15 calibrating a pull-down of the off chip
16 driver;
17 and,
18 if in a normal mode to receive data, then
19 selecting the pull-up calibration terminal
20 and the pull-down calibration terminal to be
21 coupled to the voltage reference node to provide a
22 reference voltage thereon, and
23 receiving data from a data terminal.

1 12. (Original) The method of claim 11 further
2 comprising:
3 prior to selecting, calibrating and receiving,
4 coupling an external pull-up resistor to the
5 pull-up calibration terminal; and
6 coupling an external pull-down resistor to
7 the pull-down calibration terminal.

1 13. (Original) The method of claim 11, wherein
2 the receiving data from the data terminal includes

3 comparing the reference voltage on the voltage
4 reference node with an incoming signal on the data
5 terminal.

1 14. (Original) The method of claim 13, wherein
2 the calibrating of the pull-up of the off chip
3 driver includes
4 comparing the pull-up calibration voltage on the
5 voltage reference node with an incoming signal on the
6 data terminal.

1 15. (Original) The method of claim 14, wherein
2 the calibrating of the pull-down of the off chip
3 driver includes
4 comparing the pull-down calibration voltage on the
5 voltage reference node with an incoming signal on the
6 data terminal.

1 16. (Original) A system comprising:
2 a processor for executing instructions and
3 processing data;
4 a double data rate memory device to store data
5 from the processor and to read data to the processor;
6 an external pull-up resistor having a first end
7 coupled to a first power supply terminal;

8 an external pull-down resistor having a first end
9 coupled to a second power supply terminal; and
10 a memory controller coupled between the double
11 data rate memory device and the processor, the memory
12 controller including
13 a pull-up calibration terminal coupled to a
14 second end of the external pull-up resistor,
15 a pull-down calibration terminal coupled to a
16 second end of the external pull-down resistor,
17 a voltage reference node,
18 a first switch having a first switch
19 connection coupled to the pull-up calibration
20 terminal and a second switch connection coupled to
21 the voltage reference node, and
22 a second switch having a first switch
23 connection coupled to the pull-down calibration
24 terminal and a second switch connection coupled to
25 the voltage reference node.

1 17. (Original) The system of claim 16, wherein
2 the memory controller is an integrated circuit
3 separate from the processor.

1 18. (Original) The system of claim 16, wherein
2 the processor is an integrated circuit and
3 includes the memory controller.

1 19. (Original) The system of claim 16, wherein
2 the memory controller further includes
3 a switch controller having a mode input, a
4 first control output coupled to a control input of
5 the first switch, and a second control output
6 coupled to a control input of the second switch,
7 the switch controller to control the opening and
8 closing of the first switch and the second switch
9 in response to the mode input.

1 20. (Currently Amended) The system of claim 19,
2 wherein
3 the first switch and the second switch are
4 selectively closed to generate an internal voltage
5 reference on the voltage reference node with which an
6 input signal [[may be]] is compared in order to receive
7 data;
8 the first switch is selectively closed and the
9 second switch is selectively opened to generate a pull-
10 up calibration voltage on the voltage reference node to
11 calibrate a driver of the DDR memory device; and
12 the first switch is selectively opened and the
13 second switch is selectively closed to generate a pull-
14 down calibration voltage on the voltage reference node

15 to further calibrate the driver of the DDR memory
16 device.

1 21. (Cancelled)

1 22. (Currently Amended) A [[The]] processor of claim
2 21, wherein for a computer system, the processor including:
3 a memory controller to interface to memory, the
4 memory controller further has having
5 a pull-up calibration terminal to couple to
6 an external pull-up resistor,
7 a pull-down calibration terminal to couple to
8 an external pull-down resistor,
9 a voltage reference node,
10 a first switch coupled between the pull-up
11 calibration terminal and the voltage reference
12 node,
13 a second switch coupled between the pull-down
14 calibration terminal and the voltage reference
15 node, and
16 a switch controller having a mode input, a
17 first control output coupled to a control input of
18 the first switch, and a second control output
19 coupled to a control input of the second switch,
20 the switch controller to control the opening and

21 closing of the first switch and the second switch
22 in response to the mode input.

1 23. (Currently Amended) The processor of claim 22,
2 wherein
3 the first switch and the second switch are
4 selectively closed to generate an internal voltage
5 reference on the voltage reference node with which an
6 input signal [[may be]] is compared in order to receive
7 data from a driver of a [[DDR]] memory device;
8 the first switch is selectively closed and the
9 second switch is selectively opened to generate a pull-
10 up calibration voltage on the voltage reference node to
11 calibrate the driver of the [[DDR]] memory device; and
12 the first switch is selectively opened and the
13 second switch is selectively closed to generate a pull-
14 down calibration voltage on the voltage reference node
15 to further calibrate the driver of the [[DDR]] memory
16 device.

1 24. (Original) A packaged integrated circuit to
2 interface to memory, the packaged integrated circuit
3 comprising:
4 a first off-chip driver calibration terminal to
5 couple to a first external resistor;

6 a second off-chip driver calibration terminal to
7 couple to a second external resistor;

8 a first plurality of field effect transistors
9 having sources coupled in parallel together to the
10 first off-chip driver calibration terminal and drains
11 coupled in parallel together to a voltage reference
12 node; and

13 a second plurality of field effect transistors
14 having drains coupled in parallel together to the
15 second off-chip driver calibration terminal and sources
16 coupled in parallel together to the voltage reference
17 node.

1 25. (Original) The packaged integrated circuit of
2 claim 24 wherein

3 the first plurality of field effect transistors
4 and the second plurality of field effect transistors
5 are p-channel field effect transistors.

1 26. (Original) The packaged integrated circuit of
2 claim 24 wherein

3 the first plurality of field effect transistors
4 and the second plurality of field effect transistors
5 are n-channel field effect transistors.

1 27. (Original) The packaged integrated circuit of
2 claim 24 wherein
3 the first plurality of field effect transistors
4 are p-channel field effect transistors, and
5 the second plurality of field effect transistors
6 are n-channel field effect transistors.

1 28. (Original) The packaged integrated circuit of
2 claim 24 wherein
3 the first plurality of field effect transistors
4 are n-channel field effect transistors, and
5 the second plurality of field effect transistors
6 are p-channel field effect transistors.

1 29. (Original) The packaged integrated circuit of
2 claim 24 wherein
3 the first plurality of field effect transistors
4 are p-channel field effect transistors and n-channel
5 field effect transistors having sources coupled in
6 parallel together and drains coupled in parallel
7 together, and
8 the second plurality of field effect transistors
9 are p-channel field effect transistors and n-channel
10 field effect transistors having sources coupled in

11 parallel together and drains coupled in parallel
12 together.

1 30. (Original) The packaged integrated circuit of
2 claim 24 further comprising:
3 a switch controller having a mode input, a first
4 plurality of switch control signals coupled to
5 respective gates of the first plurality of field effect
6 transistors, a second plurality of switch control
7 signals coupled to respective gates of the second
8 plurality of field effect transistors, the switch
9 controller to control the switching of the first and
10 second plurality of field effect transistors.

1 31. (Original) The packaged integrated circuit of
2 claim 24 further comprising:
3 a plurality of input receivers each having a first
4 input coupled to the voltage reference node and a
5 second input coupled to respective data terminals to
6 receive data.

1 32. (Original) The packaged integrated circuit of
2 claim 31, wherein
3 each input receiver includes
4 a comparator having a first input coupled to the
5 voltage reference node and a second input coupled to a

6 respective data terminal to calibrate a pull-up and a
7 pull-down of an off-chip output driver.

1 33. (Original) The packaged integrated circuit of
2 claim 32, wherein

3 the comparator of each input receiver further to
4 receive data by comparing a reference voltage on the
5 reference node with an input signal on the respective
6 data terminal.

1 34. (New) The integrated circuit of claim 5,
2 further comprising:

3 a switch controller having a mode input, a first
4 control output coupled to a control input of the first
5 switch, and a second control output coupled to a
6 control input of the second switch, the switch
7 controller to control the opening and closing of the
8 first switch and the second switch in response to the
9 mode input.

1 35. (New) The integrated circuit of claim 34,
2 wherein

3 the first switch and the second switch are
4 selectively closed to generate an internal voltage
5 reference on the voltage reference node with which an
6 input signal is compared in order to receive data;

7 the first switch is selectively closed and the
8 second switch is selectively opened to generate a pull-
9 up calibration voltage on the voltage reference node to
10 calibrate an off-chip driver; and

11 the first switch is selectively opened and the
12 second switch is selectively closed to generate a pull-
13 down calibration voltage on the voltage reference node
14 to further calibrate the off-chip driver.

1 36. (New) The integrated circuit of claim 7,
2 wherein

3 the first switch and the second switch are
4 selectively closed to generate an internal voltage
5 reference on the voltage reference node with which an
6 input signal is compared in order to receive data.

1 37. (New) The integrated circuit of claim 7,
2 wherein

3 the first switch is selectively closed and the
4 second switch is selectively opened to generate a pull-
5 up calibration voltage on the voltage reference node to
6 calibrate an off-chip driver.

7 38. (New) The integrated circuit of claim 7,
8 wherein

9 the first switch is selectively opened and the
10 second switch is selectively closed to generate a pull-
11 down calibration voltage on the voltage reference node
12 to calibrate an off-chip driver.

13 39. (New) The processor of claim 23, wherein
14 the memory device is a double data rate (DDR)
15 memory device.